

2019

FRM[®]

Study Guide



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2019 Financial Risk Manager (FRM®) Exam Study Guide

TOPIC OUTLINE, READINGS, TEST WEIGHTINGS

The Study Guide sets forth primary topics and sub-topics covered in the FRM Exam Part I and Part II. The topics were selected by the FRM Committee as essential for today's risk managers to master. The topics and their respective weightings are reviewed yearly to ensure the Exams are timely and relevant. The Study Guide also contains a full listing of all of the readings that are recommended as preparation for the FRM Exam Part I and Part II.

Key concepts appear as bullet points at the beginning of each section and are intended to help candidates identify the major themes and knowledge areas associated with that section.

FRM EXAM APPROACH

The FRM Exams are practice-oriented. The questions are derived from a combination of theory, as set forth in the readings, and "real-world" work experience. Candidates are expected to understand risk management concepts and approaches, as well as the ways in which they would apply to a risk manager's day-to-day activities. It is rare that a risk manager will be faced with an issue that can immediately be slotted into one category. In the real world, a risk manager must be able to identify any number of risk-related issues and be able to deal with them effectively. As such, the Exams are comprehensive in nature, testing a candidate on a number of risk management concepts and approaches.

READINGS

Questions for the FRM Exams are related to and supported by the readings listed under each topic outline. These readings were selected by the FRM Committee to assist candidates in their review of the subjects covered by the Exams. It is strongly suggested that candidates review these readings in depth prior to sitting for each Exam. All of the readings listed in the FRM Study Guide are available through GARP. Further information can be found on the GARP website.

FRM EXAM PREP PROVIDERS

Some candidates may want to more formally review the materials with FRM Exam Preparation Providers (EPPs). A list of EPPs that have registered with GARP can be found on the GARP website. GARP does not endorse any EPP, but merely lists them as a service to FRM candidates.

FRM EXAM PART I

FOUNDATIONS OF RISK MANAGEMENT

QUANTITATIVE ANALYSIS

FINANCIAL MARKETS AND PRODUCTS

VALUATION AND RISK MODELS

FRM EXAM PART II

MARKET RISK MEASUREMENT AND MANAGEMENT

CREDIT RISK MEASUREMENT AND MANAGEMENT

OPERATIONAL AND INTEGRATED RISK MANAGEMENT

RISK MANAGEMENT AND INVESTMENT MANAGEMENT

CURRENT ISSUES IN FINANCIAL MARKETS

Foundations of Risk Management

PART I EXAM WEIGHT | 20%

TOPICS AND READINGS

This area focuses on foundational concepts of risk management and how risk management can add value to an organization. The broad knowledge points covered in Foundations of Risk Management include the following:

- Basic risk types, measurement and management tools
- Creating value with risk management
- The role of risk management in corporate governance
- Enterprise Risk Management (ERM)
- Financial disasters and risk management failures
- The Capital Asset Pricing Model (CAPM)
- Risk-adjusted performance measurement
- Multifactor models
- Data aggregation and risk reporting
- Ethics and the GARP Code of Conduct

To cover these broad knowledge points, a set of curated readings is listed on the following page. While detailed learning objectives associated with these readings are presented in the 2019 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

Reading 1 contains three chapters with the first two giving a broad overview of risk, different risk types, and how risks can arise in an organization. The third chapter describes the role of corporate governance in risk management including the role of the board of directors and other areas of an organization. The concept of an organization's risk appetite and how this is translated into a risk appetite framework and communicated throughout an organization is presented as well. Reading 2 introduces Enterprise Risk Management (ERM), a common and important method for assessing and managing risk in an organizational context. Reading 3 focuses more specifically on risk taking by banks and how risk management can add or destroy value in these institutions.

As it is always important to learn from history, the next several readings (Readings 4, 5, and 6) describe various financial disasters from the past with a particular focus on the recent global financial crisis. Reading 7 gives a nuanced approach to interpreting financial failures and the role that risk management may, or may not, have played in them.

Reading 8 presents the Capital Asset Pricing Model (CAPM), one of the foundational developments in risk-adjusted pricing and valuation. This is followed by a discussion, in Reading 9, of several commonly used CAPM-related risk measures and their application to performance measurement. Reading 10 moves beyond CAPM and introduces factor models and how they can be used to model returns.

Data is the lifeblood of many large financial organizations and aggregating and reporting risk data has become increasingly important. Reading 11 addresses this important topic. To help ensure ethical standards are upheld in the risk management profession, Reading 12 contains GARP's Code of Conduct, a document that all FRMs are subject to.

READINGS FOR FOUNDATIONS OF RISK MANAGEMENT

1. Michel Crouhy, Dan Galai, and Robert Mark, *The Essentials of Risk Management, 2nd Edition* (New York, NY: McGraw-Hill, 2014).
 - Chapter 1. Risk Management: A Helicopter View (Including Appendix 1.1: Typology of Risk Exposures)
 - Chapter 2. Corporate Risk Management: A Primer
 - Chapter 4. Corporate Governance and Risk Management
2. James Lam, *Enterprise Risk Management: From Incentives to Controls, 2nd Edition* (Hoboken, NJ: John Wiley & Sons, 2014).
 - Chapter 4. What is ERM?
3. René Stulz, “Risk Management, Governance, Culture and Risk Taking in Banks,” FRBNY Economic Policy Review, (August 2016): 43-59.
4. Steve Allen, *Financial Risk Management: A Practitioner’s Guide to Managing Market and Credit Risk, 2nd Edition* (New York, NY: John Wiley & Sons, 2013).
 - Chapter 4. Financial Disasters
5. Markus K. Brunnermeier, “Deciphering the Liquidity and Credit Crunch 2007-2008,” *Journal of Economic Perspectives* (2009): (23:1), 77-100.
6. Gary Gorton and Andrew Metrick, “Getting Up to Speed on the Financial Crisis: A One-Weekend-Reader’s Guide,” *Journal of Economic Literature* (2012): 50(1), 128-150.
7. René Stulz, “Risk Management Failures: What Are They and When Do They Happen?” *Journal of Applied Corporate Finance* 20, No. 4 (2008): 39-48.
8. Edwin J. Elton, Martin J. Gruber, Stephen J. Brown and William N. Goetzmann, *Modern Portfolio Theory and Investment Analysis, 9th Edition* (Hoboken, NJ: John Wiley & Sons, 2014).
 - Chapter 13. The Standard Capital Asset Pricing Model
9. Noel Amenc and Veronique Le Sourd, *Portfolio Theory and Performance Analysis* (West Sussex, UK: John Wiley & Sons, 2003).
 - Chapter 4. Applying the CAPM to Performance Measurement: Single-Index Performance Measurement Indicators (Section 4.2 only)
10. Zvi Bodie, Alex Kane, and Alan J. Marcus, *Investments, 11th Edition* (New York, NY: McGraw-Hill, 2017).
 - Chapter 10. Arbitrage Pricing Theory and Multifactor Models of Risk and Return
11. “Principles for Effective Data Aggregation and Risk Reporting,” (Basel Committee on Banking Supervision Publication, January 2013).
12. *GARP Code of Conduct*.*

*This reading is freely available on the GARP website.

Quantitative Analysis

PART I EXAM WEIGHT | 20%

TOPICS AND READINGS

This area tests a candidate's knowledge of basic probability and statistics, regression and time series analysis, and various quantitative techniques useful in risk management. The broad knowledge points covered in Quantitative Analysis include the following:

- Discrete and continuous probability distributions
- Estimating the parameters of distributions
- Population and sample statistics
- Bayesian analysis
- Statistical inference and hypothesis testing
- Estimating correlation and volatility using EWMA and GARCH models
- Volatility term structures
- Correlations and copulas
- Linear regression with single and multiple regressors
- Time series analysis and forecasting
- Simulation methods

To cover these broad knowledge points, a set of curated readings is listed on the following page. While detailed learning objectives associated with these readings are presented in the 2019 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

Reading 13 consists of five chapters. These chapters introduce basic, fundamental concepts related to probability, statistics, probability distributions, Bayesian analysis, hypothesis testing, and confidence intervals.

Regression analysis is an important statistical tool used to investigate relationships between variables. The first three chapters in Reading 14 give a general introduction to regression analysis. These chapters cover both single and multiple variable linear regression analysis. The fourth chapter presents methods for quantifying the estimation error associated with ordinary least squares regression and how to structure and evaluate tests of statistical hypotheses.

Time series data occur frequently in finance. The four chapters in Reading 15 describe methods for analyzing time series data in order to estimate statistics and extract other meaningful characteristics of the data. The first chapter focuses on modeling and forecasting trends. The second chapter focuses on modeling and forecasting seasonality. The last two chapters focus on modeling cycles.

The two chapters in Reading 16 introduce volatility, correlation and copulas and how to use the EWMA model and the GARCH(1,1) model to estimate future covariance and volatilities.

Simulation methods in finance are used to value and analyze complex financial instruments and portfolios. Reading 17 introduces simulation methods including Monte Carlo simulation and the use of the bootstrapping method. It also explains the advantages and disadvantages of the simulation approach to financial problem solving and the techniques to reduce Monte Carlo sampling error.

READINGS FOR QUANTITATIVE ANALYSIS

13. Michael Miller, *Mathematics and Statistics for Financial Risk Management, 2nd Edition* (Hoboken, NJ: John Wiley & Sons, 2013).
 - Chapter 2. Probabilities
 - Chapter 3. Basic Statistics
 - Chapter 4. Distributions
 - Chapter 6. Bayesian Analysis (pages 113-124 only)
 - Chapter 7. Hypothesis Testing and Confidence Intervals
14. James Stock and Mark Watson, *Introduction to Econometrics, Brief Edition* (Boston, MA: Pearson, 2008).
 - Chapter 4. Linear Regression with One Regressor
 - Chapter 5. Regression with a Single Regressor
 - Chapter 6. Linear Regression with Multiple Regressors
 - Chapter 7. Hypothesis Tests and Confidence Intervals in Multiple Regression
15. Francis X. Diebold, *Elements of Forecasting, 4th Edition* (Mason, OH: Cengage Learning, 2006).
 - Chapter 5. Modeling and Forecasting Trend
 - Chapter 6. Modeling and Forecasting Seasonality
 - Chapter 7. Characterizing Cycles
 - Chapter 8. Modeling Cycles: MA, AR, and ARMA Models
16. John C. Hull, *Risk Management and Financial Institutions, 5th Edition* (Hoboken, NJ: John Wiley & Sons, 2018).
 - Chapter 10. Volatility
 - Chapter 11. Correlations and Copulas
17. Chris Brooks, *Introductory Econometrics for Finance, 3rd Edition* (Cambridge, UK: Cambridge University Press, 2014).
 - Chapter 13. Simulation Methods (Note: EViews and other programming references are not required.)

Financial Markets and Products

PART I EXAM WEIGHT | 30%

TOPICS AND READINGS

This area tests your knowledge of financial products and the markets in which they trade, more specifically, the following knowledge areas:

- Structures and functions of financial institutions
- Structure and mechanics of OTC and exchange markets
- Structure, mechanics, and valuation of forwards, futures, swaps, and options
- Hedging with derivatives
- Interest rates and measures of interest rate sensitivity
- Foreign exchange risk
- Corporate bonds
- Mortgage-backed securities

To cover these broad knowledge points, a set of curated readings is listed beginning on the following page. While detailed learning objectives associated with these readings are presented in the 2019 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

Reading 18 has three chapters. The first chapter describes the structure of commercial and investment banking, the way banks are regulated, the nature of risks facing them, and the role of capital in providing cushion against losses. The second chapter explains the risks and regulations faced by insurance companies, their capital requirements and performance ratios, and the types and key characteristics of pension funds. The third chapter introduces mutual funds and hedge funds, examines their key differences, and describes various hedge fund strategies and performance measures.

Financial derivatives play a key role in risk management and their coverage is the basis of Reading 19, which has eleven chapters. Chapters 1 through 3 describe options, forwards, and futures and explain the mechanics of futures markets and central counterparties, and the hedging strategies using futures. Chapters 4 through 6 describe interest rates and interest rate sensitivity, the determination of forward and futures prices, and the use of interest rate futures in hedging. The mechanics, types, and the pricing of swaps contracts and the application of swaps for hedging are described in Chapter 7. The next four chapters explain the mechanics of options markets, and the hedging strategies involving options and exotic options. Reading 20 concludes the discussion on derivatives, defines basis risk, describes commodity forwards and futures, explains the role of carry markets, and describes the determination of the no-arbitrage values for commodity forwards and futures.

Reading 21 describes the structures and operations of central counterparties (CCPs). The exchange-traded and over-the-counter (OTC) markets are explained along with the types of risks faced by CCPs. Reading 22 describes foreign exchange risk and explains interest rate parity theorem, balance-sheet hedging, and the diversification benefits of multicurrency asset-liability positions.

The last two readings examine two important classes of fixed income securities. Reading 23 describes corporate bonds, their types and characteristics, and the distinctions between credit default risk and credit spread risk. Reading 24 defines mortgages, explains the securitization process for mortgage-backed securities, and describes prepayment modeling and the calculation of the various metrics for a typical mortgage pool.

READINGS FOR FINANCIAL MARKETS AND PRODUCTS

18. John C. Hull, *Risk Management and Financial Institutions, 5th Edition* (Hoboken, NJ: John Wiley & Sons, 2018).
 - Chapter 2. Banks
 - Chapter 3. Insurance Companies and Pension Plans
 - Chapter 4. Mutual Funds, ETFs, and Hedge Funds

19. John C. Hull, *Options, Futures, and Other Derivatives, 10th Edition* (New York, NY: Pearson, 2017).
 - Chapter 1. Introduction
 - Chapter 2. Futures Markets and central counterparties
 - Chapter 3. Hedging Strategies Using Futures
 - Chapter 4. Interest Rates
 - Chapter 5. Determination of Forward and Futures Prices
 - Chapter 6. Interest Rate Futures
 - Chapter 7. Swaps
 - Chapter 10. Mechanics of Options Markets
 - Chapter 11. Properties of Stock Options
 - Chapter 12. Trading Strategies Involving Options
 - Chapter 26. Exotic Options

20. Robert McDonald, *Derivatives Markets, 3rd Edition* (Boston, MA: Addison-Wesley, 2013).
 - Chapter 6. Commodity Forwards and Futures

21. Jon Gregory, *Central Counterparties: Mandatory Clearing and Bilateral Margin Requirements for OTC Derivatives* (New York, NY: John Wiley & Sons, 2014).
 - Chapter 2. Exchanges, OTC Derivatives, DPCs and SPVs
 - Chapter 3. Basic Principles of Central Clearing
 - Chapter 14. (Section 14.4 only). Risks Caused by CCPs: Risks Faced by CCPs

22. Anthony Saunders and Marcia Millon Cornett, *Financial Institutions Management: A Risk Management Approach, 9th Edition* (New York, NY: McGraw-Hill, 2017).
 - Chapter 13. Foreign Exchange Risk

23. Frank Fabozzi (editor), *The Handbook of Fixed Income Securities, 8th Edition* (New York, NY: McGraw-Hill, 2012).
 - Chapter 12. Corporate Bonds

24. Bruce Tuckman and Angel Serrat, *Fixed Income Securities: Tools for Today's Markets, 3rd Edition* (Hoboken, NJ: John Wiley & Sons, 2011).
 - Chapter 20. Mortgages and Mortgage-Backed Securities

Valuation and Risk Models

PART I EXAM WEIGHT | 30%

TOPICS AND READINGS

This area will test a candidate's knowledge of valuation techniques and risk models. The broad knowledge points covered in Valuation and Risk Models include the following:

- Value-at-Risk (VaR)
- Expected shortfall (ES)
- Stress testing and scenario analysis
- Option valuation
- Fixed income valuation
- Hedging
- Country and sovereign risk models and management
- External and internal credit ratings
- Expected and unexpected losses
- Operational risk

To cover these broad knowledge points, a set of curated readings is listed on the following page. While detailed learning objectives associated with these readings are presented in the 2019 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

Reading 25 consists of two chapters that introduce Value-at-Risk (VaR) estimation approaches and applications. Reading 26 covers financial risk measures and examines measurement frameworks such as the mean-variance approach, VaR, and expected shortfall (ES).

The three chapters that comprise Reading 27 present the key elements of option pricing and option sensitivities. Option valuation using binomial trees and the Black-Scholes-Merton model is covered, along with the use of options for hedging and risk management.

The five chapters that form Reading 28 are devoted to valuing and understanding risk management for fixed income securities. The first three chapters cover the various tools of fixed income valuation while the last two chapters cover risk metrics and hedging.

Reading 29 explains the specific sources of country risk and the use of external ratings in assessing sovereign default risk. A description of credit ratings, both external and internal, is further developed in the next reading. Reading 30 presents a review of external and internal rating methodologies and an assessment of the strengths and weaknesses of the rating methodologies.

The next two readings foreshadow two very important exam topics covered in Part II. Reading 31 presents the basics of credit risk, specifically expected loss (EL) and unexpected loss (UL) for both an individual security and a portfolio. Reading 32 introduces various aspects of operational risk. Stress testing, its importance, applications, and practices are explained in Readings 33 and 34.

READINGS FOR VALUATION AND RISK MODELS

25. Linda Allen, Jacob Boudoukh and Anthony Saunders, *Understanding Market, Credit and Operational Risk: The Value at Risk Approach* (New York, NY: Wiley-Blackwell, 2004).
- Chapter 2. Quantifying Volatility in VaR Models
 - Chapter 3. Putting VaR to Work
26. Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, UK: John Wiley & Sons, 2005).
- Chapter 2. Measures of Financial Risk
27. John C. Hull, *Options, Futures, and Other Derivatives, 10th Edition* (New York, NY: Pearson, 2017).
- Chapter 13. Binomial Trees
 - Chapter 15. The Black-Scholes-Merton Model
 - Chapter 19. The Greek Letters
28. Bruce Tuckman and Angel Serrat, *Fixed Income Securities: Tools for Today's Markets, 3rd Edition* (Hoboken, NJ: John Wiley & Sons, 2011).
- Chapter 1. Prices, Discount Factors, and Arbitrage
 - Chapter 2. Spot, Forward and Par Rates
 - Chapter 3. Returns, Spreads and Yields
 - Chapter 4. One-Factor Risk Metrics and Hedges
 - Chapter 5. Multi-Factor Risk Metrics and Hedges
29. Aswath Damodaran, "Country Risk: Determinants, Measures and Implications - The 2018 Edition" (July 23, 2018). (pages 1-49 only).
30. Arnaud de Servigny and Olivier Renault, *Measuring and Managing Credit Risk* (New York, NY: McGraw-Hill, 2004).
- Chapter 2. External and Internal Ratings
31. Gerhard Schroeck, *Risk Management and Value Creation in Financial Institutions* (New York, NY: John Wiley & Sons, 2002).
- Chapter 5. Capital Structure in Banks (pages 170-186 only)
32. John C. Hull, *Risk Management and Financial Institutions, 5th Edition* (Hoboken, NJ: John Wiley & Sons, 2018).
- Chapter 23. Operational Risk
33. *Stress Testing: Approaches, Methods, and Applications*, Edited by Akhtar Siddique and Iftekhar Hasan (London, UK: Risk Books, 2013).
- Chapter 1. Governance over Stress Testing
 - Chapter 2. Stress Testing and Other Risk Management Tools
34. "Principles for sound stress testing practices and supervision" (Basel Committee on Banking Supervision Publication, May 2009).

Market Risk Measurement and Management

PART II EXAM WEIGHT | 25%

TOPICS AND READINGS

This area focuses on market risk measurement and management techniques. The broad knowledge points covered in Market Risk Measurement and Management include the following:

- VaR and other risk measures
 - Parametric and non-parametric methods of estimation
 - VaR mapping
 - Backtesting VaR
 - Expected shortfall (ES) and other coherent risk measures
- Modeling dependence: correlations and copulas
- Term structure models of interest rates
- Volatility: smiles and term structures

To cover these broad knowledge points, a set of curated readings is listed on the following page. While detailed learning objectives associated with these readings are presented in the 2019 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

The importance of developing an understanding of VaR and other common risk measures used to assess risk cannot be overstated. Reading 35 presents both parametric and non-parametric estimation techniques for VaR and ES. Backtesting as a form of model validation as support for the use of VaR, and VaR mapping as a tool to address portfolio risk factors are presented in the two chapters of Reading 36. Reading 37 completes the risk measures coverage by showing the uses and applications of VaR and ES in a trading book context and also addresses some of the recent academic literature associated with market risk management.

Modern risk management requires an understanding of correlation risk. Reading 38 explains the basics of correlation risk and explores the empirical properties, models, and modeling approaches related to correlation risk. The first chapter covers the basics of correlation risk and how it is related to credit risk, market risk, systematic risk, and concentration risk. The second chapter includes how correlations behave in different economic states as well as mean reversion and autocorrelation. The third chapter demonstrates how to apply statistical correlation models. The last chapter explains the purpose and uses of copula functions.

The five chapters in Reading 39 all are associated with term structure models and their impact on hedging. Various regression hedges are explained in the first chapter. Term structure models that deal with drifts, mean reversions, negative short-term rates, and time dependent volatilities are all reviewed. Specific term structure models, such as the Ho-Lee, Vasicek, Cox-Ingersoll-Ross, and lognormal models are discussed in this reading.

Reading 40 covers very specific concepts related to the occurrence of volatility “smiles.”

READINGS FOR MARKET RISK MEASUREMENT AND MANAGEMENT

- 35. Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, UK: John Wiley & Sons, 2005).**
- Chapter 3. Estimating Market Risk Measures: An Introduction and Overview
 - Chapter 4. Non-parametric Approaches
- 36. Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition* (New York, NY: McGraw-Hill, 2007).**
- Chapter 6. Backtesting VaR
 - Chapter 11. VaR Mapping
- 37. “Messages from the academic literature on risk measurement for the trading book,” Basel Committee on Banking Supervision, Working Paper No. 19, January 2011.**
- 38. Gunter Meissner, *Correlation Risk Modeling and Management* (New York, NY: John Wiley & Sons, 2014).**
- Chapter 1. Some Correlation Basics: Properties, Motivation, Terminology
 - Chapter 2. Empirical Properties of Correlation: How Do Correlations Behave in the Real World?
 - Chapter 3. Statistical Correlation Models—Can We Apply Them to Finance?
 - Chapter 4. Financial Correlation Modeling—Bottom-Up Approaches (Sections 4.3.0 [intro], 4.3.1, and 4.3.2 only)
- 39. Bruce Tuckman and Angel Serrat, *Fixed Income Securities: Tools for Today’s Markets, 3rd Edition* (Hoboken, NJ: John Wiley & Sons, 2011).**
- Chapter 6. Empirical Approaches to Risk Metrics and Hedging
 - Chapter 7. The Science of Term Structure Models
 - Chapter 8. The Evolution of Short Rates and the Shape of the Term Structure
 - Chapter 9. The Art of Term Structure Models: Drift
 - Chapter 10. The Art of Term Structure Models: Volatility and Distribution
- 40. John C. Hull, *Options, Futures, and Other Derivatives, 10th Edition* (New York, NY: Pearson, 2017).**
- Chapter 20. Volatility Smiles

Credit Risk Measurement and Management

PART II EXAM WEIGHT | 25%

TOPICS AND READINGS

This area focuses on a candidate's understanding of credit risk management, with some focus given to structured finance and credit products such as collateralized debt obligations and credit derivatives. The broad areas of knowledge covered in readings related to Credit Risk Measurement and Management include the following:

- Credit analysis
- Default risk: Quantitative methodologies
- Expected and unexpected loss
- Credit VaR
- Counterparty risk
- Credit derivatives
- Structured finance and securitization

To cover these broad knowledge points, a set of curated readings is listed on the following page. While detailed learning objectives associated with these readings are presented in the 2019 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

Reading 41 includes two chapters that introduce the key themes of credit risk management. The first chapter discusses the components of credit risk, types of credit risk analysis, credit risk measurements, and factors that cause credit risk. The second chapter describes various credit analyst roles and research skills expected of a credit risk analyst. The role of ratings in supporting credit risk management and rating assignment methodologies are discussed in the two chapters of Reading 42. The first chapter explains drivers and classifications of credit risk and conditions necessary for value creation, subject to capital requirements. The second chapter describes the key features of a good rating system, relates ratings to the probability of default, and analyzes different approaches to predicting default. Reading 43 describes different approaches to credit risk modeling and assesses credit derivatives.

Reading 44 includes three chapters that cover portfolio and structured credit risk. The first chapter describes default intensity models, explains credit spread risk, and defines the relationship between a default probability and a hazard rate. The second chapter defines default correlation for credit portfolios and assesses the impact of correlation on credit VaR. The third chapter describes common types of structured products, the mechanics of a securitization, and explains how default sensitivities for tranches are measured.

Counterparty risk is covered in eight chapters that form Reading 45. The first three chapters identify ways of managing and mitigating counterparty risk and describe the effects of netting, close-out, and collateral on credit exposure. The fourth chapter describes credit exposure and funding, and this is followed by chapters on counterparty risk intermediation and default probabilities, credit spreads, and funding costs. The last two chapters cover the determination of credit exposure and the pricing of and exposure profiles for derivative contracts and two chapters covering the analysis of credit and debt value adjustments and the concept of wrong-way risk. Reading 46 describes stress tests on CVA and the calculation of Debt Value Adjustment (DVA).

Reading 47 defines and compares the risk management and scoring models of retail and corporate credit risk. Reading 48 describes Special Purpose Vehicles (SPVs) and explains performance analysis tools for securitized structures. Finally, Reading 49 examines the subprime mortgage credit securitization process in the US and explains the implications of credit ratings on subprime mortgage backed securities.

READINGS FOR CREDIT RISK MEASUREMENT AND MANAGEMENT

41. Jonathan Golin and Philippe Delhaise, *The Bank Credit Analysis Handbook, 2nd Edition* (Hoboken, NJ: John Wiley & Sons, 2013).
 - Chapter 1. The Credit Decision
 - Chapter 2. The Credit Analyst
42. Giacomo De Laurentis, Renato Maino, and Luca Molteni, *Developing, Validating and Using Internal Ratings* (West Sussex, UK: John Wiley & Sons, 2010).
 - Chapter 2. Classifications and Key Concepts of Credit Risk
 - Chapter 3. Ratings Assignment Methodologies
43. René Stulz, *Risk Management & Derivatives* (Florence, KY: Thomson South-Western, 2002).
 - Chapter 18. Credit Risks and Credit Derivatives
44. Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011).
 - Chapter 7. Spread Risk and Default Intensity Models
 - Chapter 8. Portfolio Credit Risk (Sections 8.1, 8.2, 8.3 only)
 - Chapter 9. Structured Credit Risk
45. Jon Gregory, *The xVA Challenge: Counterparty Credit Risk, Funding, Collateral, and Capital, 3rd Edition* (West Sussex, UK: John Wiley & Sons, 2015).
 - Chapter 4. Counterparty Risk
 - Chapter 5. Netting, Close-out and Related Aspects
 - Chapter 6. Collateral
 - Chapter 7. Credit Exposure and Funding
 - Chapter 9. Counterparty Risk Intermediation
 - Chapter 12. Default Probabilities, Credit Spreads, Funding Costs
 - Chapter 14. Credit and Debt Value Adjustment
 - Chapter 17. Wrong-way Risk
46. *Stress Testing: Approaches, Methods, and Applications*, Edited by Akhtar Siddique and Iftekhar Hasan (London, UK: Risk Books, 2013).
 - Chapter 4. The Evolution of Stress Testing Counterparty Exposures
47. Michel Crouhy, Dan Galai and Robert Mark, *The Essentials of Risk Management, 2nd Edition* (New York, NY: McGraw-Hill, 2014).
 - Chapter 9. Credit Scoring and Retail Credit Risk Management
 - Chapter 12. The Credit Transfer Markets-and Their Implications
48. Moorad Choudhry, *Structured Credit Products: Credit Derivatives & Synthetic Securitization, 2nd Edition* (New York, NY: John Wiley & Sons, 2010).
 - Chapter 12. An Introduction to Securitization
49. Adam Ashcraft and Til Schuermann, “Understanding the Securitization of Subprime Mortgage Credit,” Federal Reserve Bank of New York Staff Reports, No. 318 (March 2008).

Operational and Integrated Risk Management

PART II EXAM WEIGHT | 25%

TOPICS AND READINGS

This area focuses on methods to measure and manage operational risk as well as methods to manage risk across an organization, including risk governance, stress testing, and regulatory compliance. The broad knowledge points covered in Operational and Integrated Risk Management include the following:

- Principles for sound operational risk management
- Enterprise Risk Management (ERM) and enterprise-wide risk governance
- IT infrastructure and data quality
- Internal and external operational loss data
- Methods of determining operational risk capital for regulatory purposes
- Model risk and model validation
- Extreme value theory (EVT)
- Risk-adjusted return on capital (RAROC)
- Economic capital frameworks and capital planning
- Liquidity risk measurement and management
- Failure mechanics of dealer banks
- Stress testing banks
- Third-party outsourcing risk
- Risks related to money laundering and financing of terrorism
- Regulation and the Basel Accords

To cover these broad knowledge points, a set of curated readings is listed beginning on the following page. While detailed learning objectives associated with these readings are presented in the 2019 FRM Learning Objectives, a brief summary of how to relate these readings to the knowledge points follows.

Readings 50 through 53 cover operational risk governance and ERM, including recommended principles to manage operational risk, governance principles for risk appetite frameworks, and data quality management. Readings 54 and 55 discuss methods of measuring and reporting operational losses and the use of internal and external operational loss data. The second chapter in Reading 55 presents methods of measuring operational risk capital recommended by the Basel Committee.

Readings 56 and 57 present issues related to modeling extreme losses, identifying and mitigating model risk, and validating models. Reading 58 introduces capital planning and risk-adjusted return on capital, while readings 59 and 60 extend the discussion by presenting best practices in capital planning.

The important subject of liquidity risk is covered in Readings 61 through 63. This includes the use of repurchase agreements, liquidity adjustments to VaR, and methods to manage funding and transactions liquidity risk. Readings 64 and 65 present a discussion of how banks can prepare for and respond to periods of financial distress, including stress testing approaches. The section concludes with a discussion of regulatory guidelines and requirements, including guidelines for managing outsourcing risk in Reading 66, a comprehensive overview of the Basel regulations in Readings 67 through 69, and risks related to money laundering and financing of terrorism in Reading 70. For the interested candidate, the full Basel regulation documents are presented as optional readings.

READINGS FOR OPERATIONAL AND INTEGRATED RISK MANAGEMENT

50. “Principles for the Sound Management of Operational Risk,” (Basel Committee on Banking Supervision Publication, June 2011).
51. Brian Nocco and René Stulz, “Enterprise Risk Management: Theory and Practice,” *Journal of Applied Corporate Finance* (2006): 18(4), 8–20.
52. “Observations on Developments in Risk Appetite Frameworks and IT Infrastructure,” Senior Supervisors Group, December 2010.
53. Anthony Tarantino and Deborah Cernauskas, *Risk Management in Finance: Six Sigma and Other Next Generation Techniques* (Hoboken, NJ: John Wiley & Sons, 2009).
 - Chapter 3: Information Risk and Data Quality Management
54. Marcelo G. Cruz, Gareth W. Peters, and Pavel V. Shevchenko, *Fundamental Aspects of Operational Risk and Insurance Analytics: A Handbook of Operational Risk* (Hoboken, NJ: John Wiley & Sons, 2015).
 - Chapter 2: OpRisk Data and Governance
55. Philippa X. Girling, *Operational Risk Management: A Complete Guide to a Successful Operational Risk Framework* (Hoboken, NJ: John Wiley & Sons, 2013).
 - Chapter 8. External Loss Data
 - Chapter 12. Capital Modeling
56. Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, UK: John Wiley & Sons, 2005).
 - Chapter 7. Parametric Approaches (II): Extreme Value
57. Giacomo De Laurentis, Renato Maino, Luca Molteni, *Developing, Validating and Using Internal Ratings* (Hoboken, NJ: John Wiley & Sons, 2010).
 - Chapter 5. Validating rating models
58. Michel Crouhy, Dan Galai and Robert Mark, *The Essentials of Risk Management, 2nd Edition* (New York, NY: McGraw-Hill, 2014).
 - Chapter 15. Model Risk
 - Chapter 17. Risk Capital Attribution and Risk-Adjusted Performance Measurement
59. “Range of practices and issues in economic capital frameworks,” (Basel Committee on Banking Supervision Publication, March 2009).
60. “Capital Planning at Large Bank Holding Companies: Supervisory Expectations and Range of Current Practice,” Board of Governors of the Federal Reserve System, August 2013.
61. Bruce Tuckman and Angel Serrat, *Fixed Income Securities: Tools for Today’s Markets, 3rd Edition* (Hoboken, NJ: John Wiley & Sons, 2011).
 - Chapter 12. Repurchase Agreements and Financing

READINGS FOR OPERATIONAL AND INTEGRATED RISK MANAGEMENT

62. Kevin Dowd, *Measuring Market Risk, 2nd Edition* (West Sussex, UK: John Wiley & Sons, 2005).
- Chapter 14. Estimating Liquidity Risks
63. Allan Malz, *Financial Risk Management: Models, History, and Institutions* (Hoboken, NJ: John Wiley & Sons, 2011).
- Chapter 11. Assessing the Quality of Risk Measures (Section 11.1)
 - Chapter 12. Liquidity and Leverage
64. Darrell Duffie, “The Failure Mechanics of Dealer Banks,” *Journal of Economic Perspectives* (2010): 24(1), 51-72.
65. Til Schuermann, “Stress Testing Banks,” prepared for the Committee on Capital Market Regulation, Wharton Financial Institutions Center (April 2012).
66. “Guidance on Managing Outsourcing Risk,” Board of Governors of the Federal Reserve System, December 2013.
67. John C. Hull, *Risk Management and Financial Institutions, 5th Edition* (Hoboken, NJ: John Wiley & Sons, 2018).
- Chapter 15. Basel I, Basel II, and Solvency II
 - Chapter 16. Basel II.5, Basel III, and Other Post-Crisis Changes
 - Chapter 17. Regulation of the OTC Derivatives Market
 - Chapter 18. Fundamental Review of the Trading Book
68. “High-level summary of Basel III reforms,” (Basel Committee on Banking Supervision Publication, December 2017).
69. “Basel III: Finalising post-crisis reforms,” (Basel Committee on Banking Supervision Publication, December 2017): (pages 128-136 only).
70. “Sound management of risks related to money laundering and financing of terrorism,” (Basel Committee on Banking Supervision Publication, June 2017). (pages 1-32 only).

OPTIONAL REGULATORY READINGS FOR REFERENCE

Candidates are expected to understand the objective and general structure of important international regulatory frameworks and general application of the various approaches for calculating minimum capital requirements, as described in the readings above. Candidates interested in the complete regulatory framework can review the following:

“Basel II: International Convergence of Capital Measurement and Capital Standards: A Revised Framework—Comprehensive Version,” (Basel Committee on Banking Supervision Publication, June 2006).*

“Basel III: A global regulatory framework for more resilient banks and banking systems—revised version,” (Basel Committee on Banking Supervision Publication, June 2011).*

“Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools,” (Basel Committee on Banking Supervision Publication, January 2013).*

“Revisions to the Basel II market risk framework—updated as of 31 December 2010,” (Basel Committee on Banking Supervision Publication, February 2011).*

“Basel III: The net stable funding ratio.” (Basel Committee on Banking Supervision Publication, October 2014).*

“Minimum capital requirements for market risk” (Basel Committee on Banking Supervision Publication, January 2016).*

“Basel III: Finalising post-crisis reforms,” (Basel Committee on Banking Supervision Publication, December 2017).*

Risk Management and Investment Management

PART II EXAM WEIGHT | 15%

TOPICS AND READINGS

This area focuses on investment management concepts of risk management techniques applied to the investment management process. The broad knowledge points covered in Risk Management and Investment Management include the following:

- Factor theory
- Portfolio construction
- Portfolio risk measures
- Risk budgeting
- Risk monitoring and performance measurement
- Portfolio-based performance analysis
- Hedge funds

To cover these broad knowledge points, a set of curated readings is listed beginning on the following page. While detailed learning objectives associated with these readings are presented in the 2019 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

Reading 71 introduces the factor theory of investing, in which asset and portfolio returns and risk premiums are explained by their exposure to specific factors. The first chapter describes the theory of factor risk by starting with the basic single-factor risk premium theory – the CAPM. The chapter then transitions into multifactor models. The second chapter explains factors that drive risk premiums and compares two types of factors: fundamental-based factors and investment-style factors. The third chapter explores how the sets of factors used to construct a benchmark can affect portfolio alpha. The final chapter focuses on challenges in measuring performance for illiquid assets, including potential biases in illiquid asset classes' risk-adjusted returns and ways to address illiquidity in performance reporting.

Reading 72 introduces ways to construct an optimal portfolio given investment constraints.

Value-at-Risk (VaR) is an important tool in portfolio management as it explicitly accounts for leverage and portfolio diversification and provides a single measure of portfolio risk. The first chapter of Reading 73 explains how managers can measure and manage portfolio VaR. The second chapter explains some benefits of using VaR in investment management and introduces the process of risk budgeting.

As risk capital is a scarce resource, controls should exist to ensure that risk capital is used in a manner consistent with the firm's risk budget. Reading 74 explains how managers can develop a risk plan, provides some tools for risk budgeting, and introduces some guidelines for monitoring portfolio risk.

Standardized measurements are helpful for investors in comparing the performance of asset managers. Reading 75 introduces various measures to evaluate the performance of portfolio managers.

Hedge funds are private investment vehicles not open to the general investing public. Reading 76 gives a general introduction to hedge fund styles and Reading 77 describes the process of performing due diligence on funds and fund managers as part of the investment process.

READINGS FOR RISK MANAGEMENT AND INVESTMENT MANAGEMENT

71. Andrew Ang, *Asset Management: A Systematic Approach to Factor Investing* (New York, NY: Oxford University Press, 2014).
- Chapter 6. Factor Theory
 - Chapter 7. Factors
 - Chapter 10. Alpha (and the Low-Risk Anomaly)
 - Chapter 13. Illiquid Assets
72. Richard Grinold and Ronald Kahn, *Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Controlling Risk, 2nd Edition* (New York, NY: McGraw-Hill, 2000).
- Chapter 14. Portfolio Construction
73. Philippe Jorion, *Value-at-Risk: The New Benchmark for Managing Financial Risk, 3rd Edition* (New York, NY: McGraw Hill, 2007).
- Chapter 7. Portfolio Risk: Analytical Methods
 - Chapter 17. VaR and Risk Budgeting in Investment Management
74. Robert Litterman and the Quantitative Resources Group, *Modern Investment Management: An Equilibrium Approach* (Hoboken, NJ: John Wiley & Sons, 2003).
- Chapter 17. Risk Monitoring and Performance Measurement
75. Zvi Bodie, Alex Kane, and Alan J. Marcus, *Investments, 11th Edition* (New York, NY: McGraw-Hill, 2017).
- Chapter 24. Portfolio Performance Evaluation
76. G. Constantinides, M. Harris and R. Stulz, eds., *Handbook of the Economics of Finance, Volume 2B* (Oxford, UK: Elsevier, 2013).
- Chapter 17. Hedge Funds
77. Kevin R. Mirabile, *Hedge Fund Investing: A Practical Approach to Understanding Investor Motivation, Manager Profits, and Fund Performance, 2nd Edition* (Hoboken, NJ: John Wiley & Sons, 2016).
- Chapter 12. Performing Due Diligence on Specific Managers and Funds

Current Issues in Financial Markets

PART II EXAM WEIGHT | 10%

TOPICS AND READINGS

This area of the Exam will test a candidate's knowledge of the material covered by each paper. The broad knowledge points covered in Current Issues in Financial Markets include the following:

- Cyber risk
- Artificial intelligence (AI), machine learning and “big data”
- Fintech Revolution
- Central clearing and risk transformation
- Secured Overnight Financing Rate (SOFR)

To cover these broad knowledge points, a set of curated readings is listed beginning on the following page. While detailed learning objectives associated with these readings are presented in the 2019 FRM Learning Objectives document, a brief summary of how to relate these readings to the knowledge points follows.

Reading 78 presents an overview of cyber risk and an exploration of the private market's ability to provide the socially optimal level of cybersecurity. Systemic cyber risk is discussed, including how it interacts with financial stability risk. The current regulatory frameworks and supervisory approaches to the reduction of systemic risk and the measures that can help increase resiliency to cyber risk are evaluated in this reading.

Reading 79 focuses on the issues unique to big data sets and the different tools that may be required to manipulate and analyze big data. Opportunities and areas for collaboration between econometrics and machine learning are discussed, including causality and prediction. Machine learning methods to analyze large amounts of data and the application of machine learning approaches within the financial services sector are further discussed in Reading 80. A background of machine learning and an overview of machine learning methods are presented, and three areas of machine learning use are explored in this reading. Reading 81 describes the drivers that have contributed to the growing use of fintech, and the supply and demand factors that have spurred adoption of AI and machine learning in financial services. Four areas of AI and machine learning are explored, as well as the possible effects and potential benefits and risks of AI and machine learning on financial markets and how they may affect financial stability.

The “Fintech Revolution” is the focus of Reading 82, particularly an assessment of the extent to which there are changes and transformations in key areas of the financial services industry. The changes that are occurring in operations management in financial services and the impact that fintech innovations have on lending and deposit services are discussed. The fintech transformation of payment services is presented, and the issues with respect to investments, financial markets, risk management, etc., are explored in this reading.

The next reading examines how the clearing of over-the-counter transactions through Central Counterparties (CCPs) has affected risks in the financial system and whether central clearing has enhanced financial stability and reduced systemic risk. Reading 83 discusses the transformation of counterparty risk into liquidity risk. An argument is made that the main focus of risk management and financial stability analysis should be on the liquidity of clearing members and the liquidity resources of CCPs.

Reading 84 offers an introduction to the Secured Overnight Financing Rate (SOFR). The reading compares the underlying interest rate exposures for SOFR futures versus those for other short-term interest rate futures to highlight characteristics to bear in mind when hedging or spreading, and to indicate normal spread relationships.

READINGS FOR CURRENT ISSUES IN FINANCIAL MARKETS

78. Emanuel Kopp, Lincoln Kaffenberger and Christopher Wilson, “Cyber Risk, Market Failures, and Financial Stability,” (August 2017). IMF Working Paper No. 17/185.*
79. Hal Varian, “Big Data: New Tricks for Econometrics,” *Journal of Economic Perspectives* (Spring 2014): 28(2), 3-28.*
80. Bart van Liebergen, “Machine Learning: A Revolution in Risk Management and Compliance?” *Institute of International Finance*, April 2017.*
81. “Artificial intelligence and machine learning in financial services,” *Financial Stability Board*, Nov. 1, 2017.*
82. Peter Gomber, Robert J. Kauffman, Chris Parker and Bruce Weber, “On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption and Transformation in Financial Services,” *Journal of Management Information Systems* (2018): 35(1), 220-265.*
83. Rama Cont, “Central clearing and risk transformation,” *Norges Bank Research*, March 2017.*
84. “What is SOFR?” *CME Group*, March 2018.*

*This reading is freely available on the GARP website.

2019 FRM Committee Members

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New York

111 Town Square Place
14th floor
Jersey City, New Jersey
07310 USA
+1 201.719.7210

London

17 Devonshire Square
4th floor
London, EC2M 4SQ
UK
+44 (0) 20.7397.9630

Washington D.C.

1001 19th Street North
#1200
Arlington, Virginia
22209 USA
+1 703.420.0920

Beijing

Unit 1010 Financial Street Centre
No 9A, Financial Street
Xicheng District
Beijing 100033 P.R. China
+86 (010) 5737.9835

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